Pebble Count Protocol

CCRWQCB adapted this protocol from the protocol used by the Sotoyome Resource Conservation District Russian River Watershed Volunteer Monitoring Program.

Objective:
Salmonids require gravel bed streams to spawn. The presence of too much fine material can adversely impact the ability of salmon eggs to develop into fry. A pebble count is a method of characterizing the material on the bed of the channel. This method is used for estimating the size distribution of the coarse (>4 mm) rocks on the surface of the channel.

Overview:
This procedure must only be conducted when there is no potential to interfere with spawning or survival of fish after their emergence from gravel as fry. Thus, the protocol is conducted on "potential" spawning gravels, rather than redds. After identifying and demarcating a potential spawning gravel feature (typically a pool tail, or, riffle crest), conduct a pebble count by randomly selecting 100 gravel particles and measuring their intermediate axis in millimeters.

A pebble count cannot give size distribution information about the fine material (less than 4-mm) on the riverbed. Pebble counts also cannot give information about the size distribution of material below the surface layer.

Field Protocol:

Filling out the Data Sheet
It is important to fill out the descriptive information on the data sheet:
- Waterbody name, study reach number, feature number
- Date of sampling, time of sampling, names of monitors
- Draw map on back of data sheet, or, preferably on pre-formatted map sheet
- Remember to remove watches, loose rings etc. before reaching underwater

Drawing the Map
Draw a map of the stream channel where the feature is located. The channel drawing should show the length of the channel for at least the length of the habitat features upstream and downstream of the feature sampled. For example, if the feature sampled is a pool tail-out, the drawing should cover the entire pool upstream and the downstream feature as well.

Face downstream: the stream bank to your left is called the left bank; the one to your right is the right-bank. The left-edge of water and the right-edge of water are determined the same way. Label your map accordingly. Draw the following features on the map.
1. Top and bottom of the banks
2. Bankfull level if clear
3. Direction of flow
4. Left and right edge of water (wetted perimeter)
5. Label the feature you are sampling, including its dimensions
6. Label other features such as pools and riffles
7. Label features that might help identify location or explain morphology (e.g., large trees, adjacent structures, culverts)
8. Indicate distance and direction of beginning of reach (e.g., "33m upstream of feature 1, 38m upstream of beginning of reach.")

Observe the channel. Look for regions with different sizes of rock, gravel and sand (texture). The textural regions are what you are going to draw on the map. Sketch the boundaries between the regions of different sized bed-material. The key to identifying the regions of different texture is to imagine that there is no water in the channel. Part of a textural region may be above the water surface and part may be below the water surface. Focus on the texture of the surface of the riverbed near the feature sampled. Ignore isolated patches that are less than 5 square feet in area. Label each of the textural regions A, B, C etc.

Performing the Pebble Count

Pebble counts are done best by a two-person team. One person selects and measures the stones and the other person records the data.

Begin by laying out the measuring tapes with tent stakes to help delineate the feature and to get dimensions for recording on the map.

A pebble count is done by randomly selecting a minimum of 100 stones and measuring the B-axis. Figure 1 shows the three axes drawn on the shape of a stone. The B-axis, also known as the intermediate axis, is the one to measure and record when doing the pebble count. The B-axis determines the sieve opening the stone can just pass through. The stones are selected by walking in the region to be sampled. Be sure to sample any portion of the region that is under water.

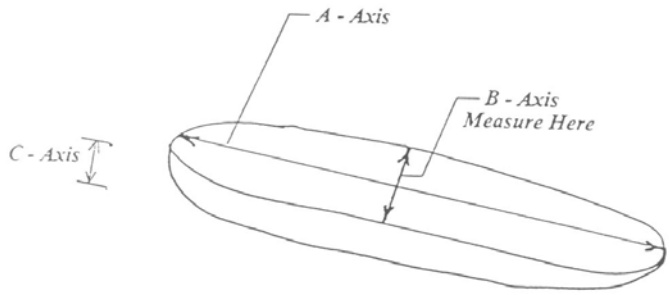

Figure 1. Measuring the stones.

- Take a step into the feature, extend your hand towards the riverbed while averting your eyes away from where you are reaching.
- Use your index finger to touch the bed just in front of the toe of your lead foot. Use the same foot and the exact same part of your finger for the duration of the pebble count.
- Select the first particle touched by your fingertip. Do not look where you are reaching. Looking at the tip of your finger tends to cause people to select larger stones.

Pick up the particle and measure its B-axis, in millimeters.

- Call out the size to your partner. Your partner will make a tally mark next to the appropriate size class on the data sheet. See the data sheet on the last page of these instructions.
- If the particle is less than 4 millimeters, do not try to measure it. Simply tell your partner, "less than 4 mm."
- If you touch a leaf or stick, move it out of the way and try selecting another rock. Avoid looking at the riverbed by your foot when you discard the leaf.
- If you are unsure if you have picked up the first pebble you touched, drop it and select another one. This is a common problem when sampling underwater.

- After measuring a rock, toss it out of the sampling area. Be careful not to throw the rock into a region that has not been sampled.
- Estimate the size of embedded particles that cannot be removed from the substrate without major disturbance of the surrounding gravel. Typically these particles will be recorded as >256mm.
- Measure only rocks that are clearly in feature you are sampling. Do not sample rocks from near the boundary of the region. Doing so might result in your accidentally crossing the boundary.
- After at least 100 pebbles have been selected and measured, count the number of tally marks in each size class for later entry into the database. The database will compute the cumulative sum and the *percent finer than*

It is important that the measured rocks are selected randomly. There are several ways to do this. One method is to start at the left edge of the region on the upstream end and walk downstream parallel to the bank. At each step select a pebble from beneath the toe of your lead foot. When you reach the downstream end of the region sidestep to your right then turn around. Walk back upstream, sampling as you step. Try adjusting your stride so that you just cover the entire region. If you do not look at the streambed when you are walking, this method will produce a random sample. There are several variations to this method such as walking across the channel instead of downstream.

Clean Up
Remove all the temporary stakes from the channel bed. Remove all the flagging used to mark the bed-material regions. Wind up all of the tapes. Pick up any trash you may have dropped.

Quality Control/Quality Assurance
A within-site variance term for surface material should also be estimated. By randomly dividing the 100-stone sample from a single site in half, two representative replicate samples are obtained. Do this for eight randomly selected sites. For each 50-stone replicate the median grain size is determined, and for each pair the difference of the estimates calculated. These can then be used to provide an estimate of within-site variance of median estimates.

Materials
1. Data Sheets
2. Waders or stream wading shoes
3. Pencils and Clipboard
4. Protocol instructions
5. Two 30-meter waterproof (nylon) measuring tapes
6. Ruler marked in millimeters
7. 6 temporary (tent) stakes

References

Kondolf, G. Mathais, *The Pebble Count Technique for Quantifying Surface Bed Material Size in Instream Flow Studies,* Rivers, Volume 3, Number 2, pages 80-87, April, 1992,

Leopold, Luna B., A *View of the River,* Harvard University Press, Cambridge, MA, 1994.

Wolman, M. Gordon, *A Method of Sampling Coarse River-Bed Material,* Transactions of the American Geophysical Union, Volume 35, Number 6, December 1954.